

EXCERPTS FROM NURSERY GROWERS GUIDE TO SNAIL-FREE OPERATIONS

Thirteen states (Alabama, Arkansas, Florida, Louisiana, Mississippi, North Carolina, Oregon, South Carolina, Tennessee, Texas, Virginia, Washington, and West Virginia) and Canada currently quarantine the European Brown Garden Snail (*Helix aspersa* = *Cryptomphalus asperses*) 'Muller', referred to here as EBGs. Some of the states regulate ornamentals, nursery stock, or other plants. Other states also regulate soil, sand, peat, gravel or any article, which may move snails. Texas has recently implemented quarantine against EBGs, which could adversely affect California nurserymen. Faced with this new Texas quarantine and trends in other states toward further regulation, pest managers from several California nurseries that are certified snail-free, along with researchers from the University of California and California Department of Food and Agriculture representatives, have compiled these guidelines for snail control.

The purpose of this guide is to provide a very practical information resource on snail control and to help regulatory officials to better understand what is involved as well as to appreciate the extent to which California nurserymen have gone to meet quarantine requirements. It describes in detail how to establish and maintain certification as free from EBGs. It discusses the factors that influence the costs, and consequently the budgeting necessary for effective control and valid quarantine certification of shipments. The advantages of snail-free certification of an entire nursery rather than of individual shipment are presented. Finally, we have included a list of references that contain more extensive and technical information of EBGs and chemicals, which aid in the selection of control methods.

There are many benefits of snail control. It enhances plant appearance by elimination of slime trails and fecal deposits. This provides a better reputation, market-share and profit for a nursery. Certification as free of EBGs opens additional markets in states that have quarantines and ensures future business to states that may initiate quarantines. Consumers in quarantine states need the supply of ornamentals from certified nurseries in California. Without this trade, markets in California and elsewhere would be flooded with the surpluses.

As information resource, these guidelines will benefit other nurseries and industries in California that ship to states with quarantines. This information will be useful to California State and county regulatory officials as well as growers and officials in the quarantine states. Since some states may refuse further shipments by a grower after a violation, anyone who could possibly ship snail-infested stock (such as growers of cut flowers, vegetables, bare-root stock, etc., and florists) should be informed on snail control. In addition, there is the possibility that shipments from an entire state may be refused after repeated violations by one or just a few of the shippers from that state. Since we are very interdependent, it is important to fully comply with necessary quarantine requirements, whether biologically valid or otherwise. In that respect, we hope that these guidelines will lead to more effective snail control and will help to displace trade-motivated restrictions with more reasoned and biologically sound pest prevention programs.

COST OF SNAIL CONTROL

We are speaking only of the European brown garden snail, not all snails, and only those costs associated with meeting the market (quarantine) demands of importing states. Several indigenous snails occur in abundance and are not under quarantine. It is expensive to establish and maintain an effective snail control program that will enable an ornamental nursery to ship plants into states that quarantine EBGs. Certification of the entire nursery rather than individual loads is preferable because it is more effective. It can eliminate the requirements, for fumigation with chemicals that frequently damage the plant material. It also allows plants to be shipped soon after orders are placed.

The basic costs for certification as snail-free accrue from the following:

1. Cut off the sources of infestations. Costs include inspection, baiting, spraying and changing specific cultural conditions in quarantine areas and at nursery perimeters. This is a continuous program.
2. Eradicate snails and retain snail-free conditions throughout the nursery. Costs again include inspection, treatment, etc., for the entire nursery.
3. Safeguard the cleanliness of shipments into snail-free states. Costs include additional inspection, treatment, etc. for all shipments. Also fees for the necessary certificates must be paid for each

destination of the shipments.

The costs of snail programs may decline significantly after the initial clean-up work is completed. The lowest possible expenditures can be attained relatively soon, only if eradication efforts are intense and maintenance procedures are complete and strictly followed. California nurseries that were surveyed estimate maintenance costs between 104 and 350 dollars per year/per acre, with the lower figures supplied by nurseries with a long-standing, snail-free certification status. The Agricultural Extension Service and chemical distributors can help growers to predict costs for establishing a snail eradication program.

Many factors influence these costs. A few to consider are:

1. Size and type of perimeters and nursery.
2. Initial snail population.
3. Types of irrigation, weather, crops, and drainage canals.
4. Turnover rate of plant material. Many old plants may be re-infested repeatedly. This requires expenditures for treatments, even if business is unprofitable.
5. The need to buy-in plant material including propagation stock.
6. Cultural practices such as graveling, spacing, etc.
7. Good weed control.
8. Involvement of every employee in the snail program.
9. Ability to quarantine plants or anything else that may harbor snails.
10. Future changes in quarantine regulations concerning snails such as fines for violations, or requirements for additional or more expensive treatments.

During the process of becoming a snail-free nursery, it is essential to involve your County Department of Agriculture in your efforts. County nursery inspection and quarantine biologists can provide valuable help in the training of personnel and monitoring your progress. They can be used as a technical resource in many cases. These authorities are your partners in helping you to achieve your goal. When you succeed, so does everyone else involved. Being a part of the effort from the start will give regulatory officials the confidence and trust that is needed to maintain a successful program.

BECOMING FREE OF SNAILS

The first step is to cut off any source of snails coming into your nursery. The primary sources of snails are the perimeters of the nursery and infested plants, which are brought into the nursery. The perimeters of a nursery vary considerably. Snails enter from bordering houses, canals, orchards, farms, overhanging trees, weeds, etc. Snails crawl slowly, but persistently. The active movement into a nursery is encouraged during wet weather. Runoffs from rain or irrigation quickly move snails over long distances. High wind or heavy rain may dislodge them from overhanging trees. Routine inspection and baiting must be increased during cloudy or wet weather. Some nurseries create barriers of copper bands or screens or lines of potassium chloride or sulfate salt around their borders. More commonly, poison baits are spread every two to four weeks at the perimeters. Yards of neighboring houses should be treated, if allowed by their owners. Points of frequent entry must be identified and routinely inspected. Weed control and other methods to reduce harborage at the perimeters will increase efficiency of snail inspection and treatment. Continual vigilance, reinspection, and retreatment of the perimeter is essential to sealing off the snail from the premises.

Incoming plant material must be quarantined until snails and their eggs are eliminated; a failure to do this will result in continual and random reinfestations throughout the nursery. A quarantine area should be utilized to physically and chemically separate all incoming plants from your field stock. Establish the quarantine area 15 or more feet away from any other plants. Gravel the soil heavily or lay down plastic. Locate this area close enough to the shipping area where plants are unloaded from the trucks, so that the transport of snail-infested plants through the nursery is kept to a minimum. Control run-off water in any manner that prevents the water-assisted, artificial movement of snails or their eggs into the field stock. Post the quarantine area with instructions not to remove any plant until released. Space the quarantined plants to facilitate routine inspection and more effective treatment. Keep this area free of weeds or piles of wood, trash, etc., that may provide harborage for snails. Plants with soil must be quarantined for at least 30 days to allow snail eggs to hatch.

During inspection, note the size of snails that you destroy. If you still find egg-laying snails, hold the material for another 30 days and intensify the treatments to eradicate the snails. Routine chemical treatments (see later sections for details) will minimize the time needed for quarantine.

After you cut off the source of snails coming into the nursery, you can begin eradication of the snails that have established themselves within the nursery. This requires the cooperation of every worker. All employees must

learn and appreciate how extensive and intensive a task it is to be snail-free, why it is important and what their individual role is at the nursery. Technical personnel should train employees to recognize what EBGS looks like, its preferred habitat, and symptoms of infestation. Supervisors issue reminders periodically and emphasize the benefits that their nursery derives from certification as snail-free. Photographs and preserved specimens of adults, juveniles, and eggs of EBGS and related pests (such as slugs, water snails, and decollate snails) should be placed where employees congregate. All workers should report snail sightings quickly, providing details as to the number and specific location. Supervisors should continually encourage this communication network and quickly transfer the information to the pest control supervisor.

Inspection is essential in the eradication process. After locating the snails, the infested plants must be immediately quarantined. Snails must be located and treated before they begin to move about the nursery and lay eggs. If treatments are delayed, then costs of control multiply because larger areas are involved, and several applications of chemicals may be necessary. The key to effective inspection is to know the pest well and where to find it. The best time for snail inspection is the early morning. Snails seek dark, moist niches. They tend to move into the foliage to feed during the night and early morning hours. Cloudy, humid weather encourages them to stay exposed longer. During rain or if the area was sprinkler irrigated the day or night before, they tend to climb higher in the plants to avoid drowning in pools of water or being washed away by currents. Snails are easy to locate under these conditions.

Snail inspection becomes more difficult later in the day or during dry weather. They move to hiding places such as drainage holes, handles or rims of pots, among dense foliage and debris underneath leaves, or between pots of plants that are packed together densely. In continually hot, dry weather, snails may seal themselves to various surfaces or seal the opening of their shell with a membrane. This is aestivation; a process that is analogous to hibernation. They might revive when conditions become favorable again.

To aid inspection, apply appropriate bait to an area suspected of harboring snails. Check the area in subsequent days for empty shells of snails you have killed, as well as other signs of snails. These are feces, slime trails, and chewing marks on leaves. Scouts should remove the signs of snails that they find so that continued activity of snails after treatments can be identified. In this way, effectiveness of chemicals or other control methods may be evaluated, and further treatment can be scheduled, if needed.

CONTROL

Control methods of EBGS must be customized to your particular situation. The most effective controls are cultural, since snails will not thrive as well in an environment that is made unsuitable for them. These methods can also be integrated with chemical means to greatly increase snail kill. Examples of this are:

1. Control weeds and remove trash, leaf litter, prunings, etc. that may harbor snails.
2. Space plants to reduce humidity and make snails easier to find and kill.
3. Gravel the grounds in order to inhibit snails from laying eggs.
4. Provide a "dead zone;" a space clean of harborage around the perimeters of the nursery.
5. Avoid growing prime hosts (such as densely growing species, Agapanthus, Lonciera, Hemerocallis, etc.) if snails are near nursery perimeters or trouble areas.
6. Clear canals of weeds and other trash that may harbor snails.
7. Remove or prune trees that overhang your perimeters from infested areas.
8. Use drip irrigation or hand watering in nursery perimeters or other areas, if sprinklers are not necessary.

These examples of cultural control methods will help workers find and kill snails, as well as increase the efficiency of chemical control methods. Chemicals can be sprayed on plants, drenched on soil, or broadcast as poison-impregnated granules or pellets, commonly known as snail bait. Consult your State agricultural extension agent and local chemical distributor for comparisons of available products and recommendations for specific situations. Most treatments can be maximized if several guidelines are followed. More important than any other rule is to quickly schedule treatments after snails are detected. Coordinate chemical treatments with irrigation. Stay aware of changing weather conditions because baiting and spraying can be ineffective if followed too closely by rain or irrigation. Water may encourage snail movement and foraging, stages that are most susceptible to chemical treatments, but it also dissipates the chemicals. An effective strategy is to irrigate and then treat plants in the afternoon, hold off further water for one to two days, check effectiveness after another day, and repeat the sequence, if you still find live snails. If egg-laying snails were present, or newly hatched snails are found later, then you will need to repeat treatment in two to four weeks. Hot weather may make it difficult to allow sufficient time between application and irrigation for chemical treatments to work well. In this case, heavier irrigation may allow more time for chemical treatment before the next irrigation. However, snails might aestivate in very hot, dry weather, and chemicals will not kill them during these periods of inactivity.

Choosing the proper chemical for the situation is extremely important both in terms of effectiveness and economics. A bait containing methaldehyde is usually highly effective. However, it fails to desiccate and kill snails during cool or wet weather or inside of extremely dense foliage where humidity remains high. Under such conditions, other more expensive baits appear to be more effective. Another factor in choosing the chemical bait is related to the size of the particle. Granules or crumbled baits may be able to penetrate an extremely dense plant canopy that a pellet would not enter. Pellets usually last longer than granules under sprinklers and may kill more snails in areas that allow proper placement of pellets. Snails in the foliage of tall trees can be sprayed to kill or dislodge them.

REMAINING SNAIL FREE

Becoming free of snails can be very difficult and expensive. Remaining snail free can be easy. You must completely cut off the sources of infestation (incoming plants, perimeters, etc.) by quarantining, inspecting, and treating as described earlier. Continued vigilance, promptness, and thoroughness are required to locate and eradicate any re-infestations. If you relax your program, then you quickly find a small snail problem is magnified many times. So is the cost to treat it!

SHIPPING PRECAUTIONS

The quickest way to trouble is to ship infested plants. This will generate a poor reputation for you among customers and inspectors in quarantine states. There are many ways to ensure the cleanliness of shipments.

First, quarantine all plants that are reinfested, so that these plants are kept from sales until they are clean again. Trace any infestations on the loading docks back to the field immediately. The shipping crew, dock checkers, loaders, truck drivers, etc., should look for snails as they handle the plants. Before loading the truck, make sure it has no snails. Every shipment of plants for snail-free areas should be inspected closely and treated on the loading docks. This also validates how well your program is working in the field. Most nurseries spray or dip each plant or apply snail bait. Select a bait that will be effective in the dark, moist, and crowded environment of the truck. Do not ship your snail-free plants in the same truck that carries infested plants from another nursery. Snails will invade your plants and the resulting trouble is solely your responsibility.

Before shipping plants to quarantine states, make sure you have all shipping documents ready. Paperwork foul-ups tend to create a bad impression.

INTERACTION WITH STATE AND COUNTY AUTHORITIES

Agricultural inspectors are integral to our cooperation with regulations of other states. California officials reassure quarantine states that California shippers are responsible and knowledgeable and that they possess the skills to prevent interstate movement of EBGs. In turn, growers should build a working rapport and trust with State and county regulatory officials. Invite county inspection personnel to see what you are doing, and to advise you about what procedures and chemicals may be necessary. What improvements could be made?

Agricultural biologist must sign certificates for snail-free shipments; so, it is vital that they know and understand your program and have confidence in it. Officials in quarantine states also need to understand your program and appreciate your desire to meet their requirements. To that end, we invite California Agricultural Commissioners and their staff to share this guide among themselves, and with officials of other states.